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THE

GAS CONSUMER'S

HANDY BOOK.

BY

WILLIAM RICHARDS, C.E.

LONDON:
E. & F. N. SPON, 46, CHARING CROSS.
NEW YORK:
446, BROOME STREET.
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Price Sixpence.

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PREFACE.

The rapidly increasing demand for the various uses of gas renders a pamphlet for the general guidance of consumers absolutely necessary, which want, it is hoped, the following pages will supply.

Wm. Richards,
Consulting Gas Engineer,
11, St. Michael's Road,
Stockwell, London.

THE GAS CONSUMER'S HANDY BOOK.

THE ADVANTAGES OF GAS.

The various advantages of gas for the purpose of illumination are now so well known and appreciated that little is required to be said on the subject. It may not be out of place, however, to observe that lighting by gas is considerably cheaper, far cleaner, more easily controlled, and attended with less trouble than any other kind of artificial illumination; it requires no store nor provision, comes instantly when demanded, and is as readily dispensed with when no longer required.

Gas lighting is as salubrious as, and infinitely more agreeable than candles and lamps, and by its dispensing with these movable lights, which were often a fruitful source of accident to life and property, it is beyond all comparison safer than these. Moreover, if any proof were requisite in order to demonstrate the vast superiority of gas over every other means of producing light, it exists in the fact, that although little more than sixty years have transpired since its first practical operation in an obscure street of the metropolis, the use of gas has extended to almost every town of importance in the civilized world. Whilst in the United Kingdom there are villages numbering respectively but five hundred inhabitants, which can boast of possessing their gasworks specially for their supply, the manufacture of gas exists, the average quality of the gas supplied is twenty-five candles, and which necessarily commands a higher price than that generally furnished in England.

During the early years of gas lighting but little attention was paid to the importance of eliminating the various impurities from gas during the process of manufacture, and this inattention retarded very considerably the progress of the "new art," but at the present time the various Acts which define the quality of gas, also stipulate stringently its degree of purity; and in most towns authorized officers are appointed to test the gas and report on its quality from time to time, and companies are liable to heavy penalties in the event of the gas supplied by them being found impure. Moreover, in order to carry out the provisions of the Acts of Parliament, eminent scientific gentlemen have been appointed by the Board of Trade as "Gas Referees," and whose duty consists in determining the quality and the state of purity of the gas supplied by the companies under their control.

Thus we may conclude that so far as the quality is defined, and the purity of the gas for any particular locality is concerned, that every provision is made to ensure these being supplied to the public.

ON ADOPTING THE USE OF GAS.

During the early years of gas lighting, gas companies presented innumerable difficulties and obstacles to the extension of their business. As instances of this, the price of gas thirty-five years ago in the metropolis was nearly three times that of the present day, without any difference in the quality. At that time gas companies often insisted on the incoming tenant paying the debt of his predecessor, even when the parties were totally unacquainted with each other; thus the con-

consumption of the gas, which are generally termed the "gas fittings," are at the exclusive cost of the consumer, and with which the gas company never interferes, nor does their responsibility extend in any way beyond the end of the service-pipe. Hence the necessity for having all these fittings properly and effectively arranged, in order that there may be a full supply, and freedom from loss, and inconvenience by the escape of gas.

The general conditions observed by companies in the United Kingdom for the payment of gas accounts are, that the quantity consumed in any quarter shall be paid during the following like term; and with all well-managed companies, in no case is a consumer permitted to be two quarters in arrears, for when approaching that period, the supply is discontinued, and the consumer is liable to be sued for the amount indebted.

On the decision being made to introduce gas into any premises, the necessary steps to be adopted are to apply to a respectable gasfitter, who will undertake all the arrangements with the gas company, and, guided by the experience of neighbours or friends using gas in dwellings of similar capacity to that to be supplied, as well as by the advice of the gasfitter, the consumer will be enabled to determine on the number and positions of the various lights that may be required. In many of the most modern dwellings the pipes for supplying the gas are placed throughout during the period of their construction, and it is to be regretted that this system is not more general, as the extra expense incurred is but trivial when compared with the convenience, and from our experience we find that in nine cases out of ten where these facilities are afforded, the tenant takes advantage of the same by adopting the use of gas.

It is generally advisable to have the whole of the soft metal pipes are placed in such localities, they are liable to "bag," or fall into recesses, at intervals, in which the vapours often condense and obstruct the passage of the gas, causing considerable annoyance and expense.

The main tap is invariably placed at the end of the company's service on the inlet of the meter, and should this not be easy of access, another tap should be placed in such a position that when desirable the gas can at any time be shut off from the house. At one period it was considered indispensable for the proper and safe employment of gas, that it should be shut off from the premises every night. But one of its great advantages is that in the event of illness or alarm of any kind it can be instantly ignited throughout the house if necessary, at least, wherever it exists. This convenience, therefore, induces people to retain the gas constantly on the premises.

Whenever gas is employed in shops, warehouses, or libraries, where goods or books are kept at the highest points, it is of the first importance to ensure good ventilation in the upper part of the locality, in order to carry off the heated air and vapours which are formed during the combustion of the gas; for although the lower part of the room may be only at a moderate temperature, often near the ceiling the heat is almost insupportable, and in consequence of the absence of proper ventilation, goods and the binding of books are frequently spoiled, and the gas is unjustly condemned.

Whenever there is an odour of escape of gas emanating from the street, cellar, drain, cistern, sewer, or anywhere in the immediate neighbourhood of the consumer's premises, written notices should be sent without delay to the company, who, regarding their own interest, will immediately attend to it, and thus prevent annoyances or accident.

Should there be signs of an escape in the interior of employed in dwellings where gas exists, is the hydraulic gasalier, which is constructed with chains and counterbalance weights, for the purpose of being raised or lowered at will. In this the gas is prevented from escaping by the intervention of a column of water in the tube, poured into the cup at the top. This apparatus has the disadvantage that the water evaporates, or by a sudden jerk in raising or lowering it, the water is caused to overflow, when in consequence of a deficiency of this, there is a probability of the gas escaping when the apparatus is drawn down; and if allowed to continue so for several hours, would become dangerous on a person entering the room with a light. Such accidents, although exceedingly rare, sometimes occur, but by a little care they can be prevented altogether, and to avoid this inconvenience, the hydaulic gasalier should be attended to every two or three months, simply by raising it to the highest, and then pouring a small quantity of water into the cup at the top until it is nearly full, when, if a teaspoonful of sweet oil or glycerine be poured on to the water, it will prevent the evaporation, and the attention required will be less frequent. The oil or glycerine once poured on the water will serve for an indefinite period.

When supplying hydraulic gasaliers with water, on no account should a light be used, for although the quantity of gas in the apartment may be small, yet as that ascends and floats in the upper part, the presence of a light might be attended with danger.

There are other kinds of sliding lights, called telescopic, which dispense with the water, chains, and counterbalance weights. In these one tube passes within another, similar to the instrument from which it is named, and a cork-tight joint prevents the gas escaping. These are much used for single-pendant lights.

Gas lights should never be placed in cellars or similarly confined places without proper ventilation in the highest part for the escape of gas, in order to avoid any mishap, in the event of this being accidentally left turned on and not ignited. In such localities it is always advisable to have a tap on the outside in addition to those inside, so that the gas can be shut off when not required, and thus avoid the chance of accident. In like manner all outside lights, such as lanterns used for displaying the goods exposed in windows, should be provided with a second tap inside the premises and within reach, in order to prevent the loss of gas which frequently arises from want of care on this point, when the consumer complains with apparent reason, that he "had not consumed any more gas than before;" but here it must be borne in mind that the meter indicates the quantity of gas which *passes*, without any reference as to how it is employed, and gas, like every other commodity, demands care on the part of the consumer, in order to prevent its waste or loss, and if this occurs through his negligence it must necessarily be at his cost.

The general management of gas is of the greatest simplicity, and it is only where downright negligence exists that any accident can occur; and although some cautions have been suggested in the foregoing instructions, this has been done with the hope of inspiring confidence and removing doubt, and with the view to prevent even the few chances of accident that may exist.

VARIOUS APPLICATIONS OF GAS.

In addition to gas being used for lighting, it is applied with great advantage for warming apartments, and cooking, as well as for many other purposes, which are foreign to our present object. We will therefore confine our observations to the two first points, which are undoubtedly of universal importance.

First, as regards the adaptability of gas for warming apartments: it has been frequently ascertained by experiments that in the ordinary house fire the greater portion of the heat derived from the fuel passes direct to the atmosphere. The loss from this source was estimated by Dr. Arnott at about nine-tenths of the heat produced from the combustion of the coal, and for which purpose extraordinary facilities are afforded by large chimneys and the door of the apartment being repeatedly opened. Indeed, in many places where the temperature is all that can be desired, by simply opening the door for a short time in severe cold weather, the warm atmosphere is carried up the chimney and replaced by the cold air from without, producing serious inconveniences, particularly to persons of delicate health.

With the gas stove, in consequence of the absence of the chimney, or the very diminutive dimensions of this wherever it may be employed, the evils referred to are considerably modified, if not altogether avoided. Moreover as the stove is placed within the apartment and the heat is radiated throughout, consequently the whole or nearly the whole of this is rendered available. Therefore, assuming that a given amount of heat when derived from gas is four times more costly than if obtained direct from coal (which is the usual estimate), then it is evident from the preceding statement, that by avoiding the errors of the ordinary house fire with its immense chimney, and adopting the ordinary means

Gas Stoves.

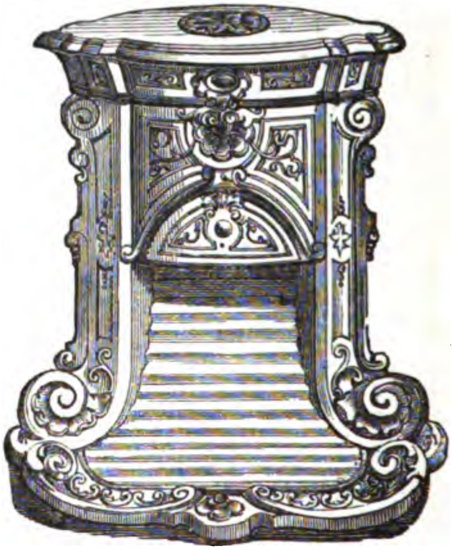
Gas stoves are manufactured to suit the means and requirements of all classes, alike for the cottage or the palace, at prices varying from a few shillings to as many guineas, and in the majority of which tasteful design is displayed. With the cheaper descriptions the gas is generally consumed without any regard to appearance, the flame being hidden within the stove. In others the gas jets are reflected on copper reflectors, which give a cheerful aspect to the apparatus; and some of the more expensive kinds are so arranged that when the gas is burned, a coke fire, or ignited wooden logs, are imitated, which arrangements are intended simply to please the eye, for it is obvious that the heat derived from the gas cannot be augmented by these means.

For small offices or rooms the simplest description of gas stove is the best, which, together with the indian rubber tube for attaching it to a neighbouring gas bracket, will cost about 20*s.* Estimating the gas at 4*s.* per 1000 feet, the cost for eight hours is about 1½*d.*, and will not exceed 2*d.* per diem of that number of hours.

Such a stove, at the expense stated, will be sufficient for an office 10 feet square, which it will maintain at an agreeable degree of temperature. It is always advisable to have the gas stove as a fixture, by having it connected with metal pipe, and dispensing with the indian rubber pipe, thus avoiding considerable inconvenience which the latter often produces; and in many cases, whether indian rubber or metal pipe is employed, the cost will be the same.

As the magnitude of apartments becomes increased, the stoves for warming them of necessity require to be augmented in their dimensions in a corresponding manner, and in some places it may be necessary to have two or more of these placed, so as to bring the temperature of the locality, to an agreeable degree of warmth throughout; and to maintain this, there should be two doors to the apartment or office, so that on a person entering, one of them is closed before the other is opened.

FIG. 1.



When expense is not a consideration, gas stoves can be procured of very elegant design, of which the above engraving, Fig. 1, may be taken as an example. This consists of a cast-iron frame, within the upper part of which is placed a row of gas jets; the lower part of the back of the stove is formed by a corrugated copper reflector, which being polished, each corrugation reflects the light of the jets above, and produces a cheerful and pleasing effect. This is very appropriately termed the "cheerful stove," and will keep an apartment 16 feet square at an agreeable temperature in the depth of winter at a cost of *4d.* or *5d.* per diem.

The methods of constructing gas stoves, in addition to those enumerated, are various: some are made of terra-cotta, of a more or less ornamental character; with others, tubes connected to the stoves are distributed about the apartment, which is warmed by the heat radiating from the tubes; and in a stove made by Messrs. Leoni and Co., all the products of combustion are carried out of the locality, and fresh air is constantly admitted at a temperature of 80° or 90°; which system is admirably suited for invalids.

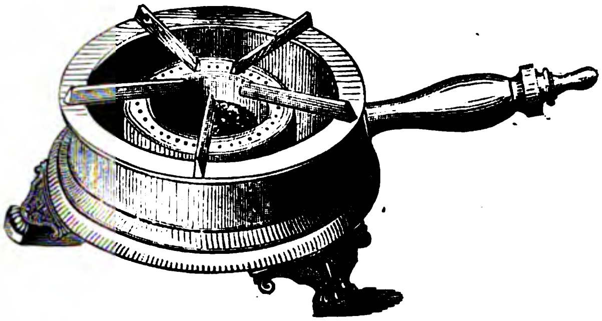
In some instances, either arising from the number of persons employed in the apartment, or from the circumstance that the door is continually closed, it may be requisite to make provision for a degree of ventilation; for this purpose a small orifice of two inches square should be made in the uppermost part of the partition or wall, into a passage or staircase, taking care that it is made in such a position that the down draught will not affect either of the inhabitants. Some large gas stoves are provided with a pipe especially for ventilation, which pipe is communicated either with a chimney, or with a passage or staircase, as already mentioned; but should the communication be made with a chimney, all other opening, except that for the passage of the pipe, should be closed.

In the chapter on Ventilation other points in reference to warming apartments are entered upon.

GAS COOKING APPARATUS.

It should be here stated that in stoves, as well as in cooking apparatus, the gas is employed in two distinct manners: in the one, by simply burning it as it issues from orifices or single jets. The other method, which is strongly recommended on account of the complete absence of smoke or soot and the perfect cleanliness of the operation, consists in a quantity of atmospheric air being mixed with the gas just previous to ignition, so that the flame is rendered blue, and practically devoid of light, whilst all the heating power of the gas is retained, and is called the atmospheric burner. In both cases when employed for cooking, the jets of gas impinge on the vessel, or the heat is often reflected on to the food, by which means it is cooked; or the jets may be beneath and surround the joint.

FIG. 2.



The simplest kind of these apparatus, called the atmospheric boiling stove, which, in one form or another, we venture to observe should be used in every dwelling wherever gas is employed, is shown in Fig. 2.

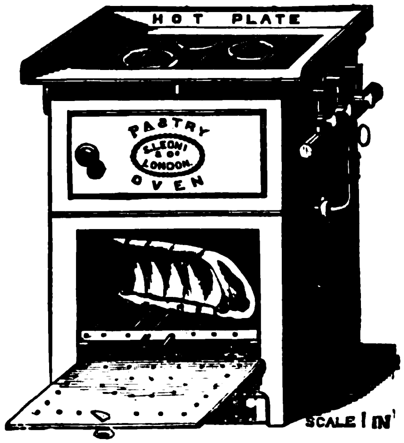
This consists of a small cast-iron stand, varying from 5 to 8 inches in diameter, provided at its centre with a perforated ring where the mixture of gas and air is burned. As represented, it is provided with a handle, to which is attached an indian rubber pipe, for the purpose of connecting the apparatus with a gas bracket or other available means.

From this it will be understood that the stove is intended to be portable, but from our observations of its utility no kitchen should be without it; it should, therefore, be a fixture, and if placed in any available corner on a small shelf of about a foot square is all that is required.

With this little apparatus, the boiling water for the breakfast of a family can be obtained in ten minutes, without soiling the fingers, at the cost of half a farthing for gas. Nor is this all, for the space beneath serves admirably for cooking ham, bacon, eggs, and with the larger description of stoves even chops may be cooked, but of course the odour arising from some of these may be objectionable, to avoid which, the apparatus may be rendered portable, and placed on the range, so that the fumes may escape up the chimney.

However, when applied for boiling only, the convenience of the boiling stove is hardly capable of being exaggerated, for it is brought into operation in an instant, and is as readily dispensed with; its action is more rapid than an ordinary fire; there is neither smoke, soot, nor smell, and the cost for gas is but trifling, and once adopted, the merits of the boiling stove cannot fail to be appreciated. The prices of this apparatus range from 2*s.* 6*d.* upwards; for a family of six persons, the cost is about 5*s.*, to which must be added the expense of the indian rubber or other pipe for attaching it. A description of boiling stove is manufactured, which can be hung on the bars of an compartments. The upper compartment forms an oven, and as represented its door is closed. At the top of the lower compartment is a ring of gas jets, the heat of which is reflected on to the joint of meat beneath, the oven is also heated by the jets mentioned. On the top of the stove there are three ring burners, each of which is suitable for a saucepan or other similar vessel, one or all of which can be used as desired. The price of this apparatus is 3*l.*, and the cost of gas may be fairly estimated at one-half of that of the coal required to prepare a dinner of any particular kind.

Fig. 3.



Larger descriptions of cooking stoves are made suitable for families; one of these, for a family of ten persons, in which the roasting is effected by reflection, the oven being heated by the waste heat from the roasting, with the means of carrying on the operations trader of Westbourne Grove, London. According to the former gentleman the economy effected by gas cooking at the establishment named, is 18 per cent. less waste of meat than when roasted by the old system, and the actual saving per annum in meat is estimated at no less than 296*l.*

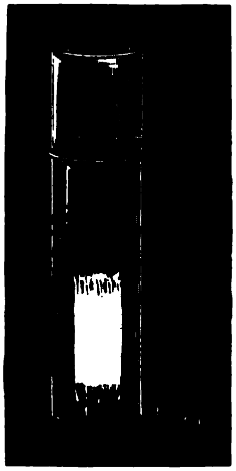
At Mr. Whiteley's establishment the food for 1200 persons is daily provided, for which 600 lbs. or 700 lbs. of meat are roasted at a cost of 5*s.* 2*d.* for gas, and it is computed that the economy arising from this method of cooking, as "compared with the results obtained by a close kitchener," by preventing the waste of meat, is as much as 12 per cent., or equal to 800*l.* per annum saved for meat alone. Mr. Whiteley also says, "The meat is always uniformly cooked; when dished up, it is plump and well browned, and is savoury and succulent." As regards the statement that the flavour of the meat is much superior when cooked by gas, to the ordinary method, this is a well-known fact, which thousands of persons can substantiate.

But although gas cooking and warming stoves are now employed by a numerous class, they are far, very far from being appreciated in the manner they merit. This, however, to us is not surprising, as we are old enough to remember the slow progress that gas lighting made, when in some of the most public thoroughfares of the metropolis, shopkeepers hesitated, year after year, and quarter after quarter, about adopting gas, and often only when their neighbours on every side had their premises lighted by that means were the timid encouraged to decide on its use. Therefore with this example before us, the progress of warming and cooking by gas must also be expected to be gradual. We may moreover observe that, so far as our knowledge extends, thirty-three years ago there was only one maker of this class of apparatus in the with regulators, which are alike desirable for lighting as for cooking or warming. To demonstrate the importance of these considerations, if the holes of the argand or other burners are made exceedingly small, so as to demand excessive pressure for the gas to issue, under these conditions the gas gives no light whatever. Or the light derived from an argand burner of the best description can be diminished to a marvellous extent by simply substituting a long chimney instead of that properly adapted for the burner, and, as will be afterwards explained, by diminishing the flame of the argand burner, the loss of available light is very remarkable. Therefore from these observations it can be understood that for the purpose of economy the choice of proper burners is indispensable.

The importance of the question under consideration has engaged the attention of the Gas Referees, already mentioned, by whom an elaborate series of experiments were made, at intervals extending over a period of two years, "for the purpose of ascertaining correctly and fairly the capacity of various burners to develop the illuminating power of gas."

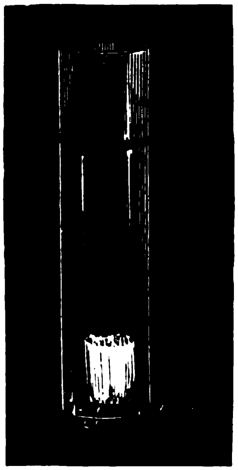
These experiments resulted in the knowledge being acquired, that one description of burner consuming a given quantity of gas yielded more than three times the quantity of light evolved from another under like conditions; or in other words, the consumer, by employing the worst description of burners in the market, would pay for the degree of light obtained, three times the amount that would be necessary with good burners. The Referees further add, "By using good burners instead of bad ones, consumers may obtain from 30 to 50 per cent. more light while their gas bills remain the same." Again, "The economy to the public arising from the use of good burners instead of bad ones is so obvious as hardly to need remark. The gas rental of current of air, to impinge on the interior and exterior of the flame as represented in the annexed figure 4. These are made of several dimensions, to consume from 3 feet to 7 feet per hour respectively, but that most generally employed burns a maximum of 5 feet per hour, which kind, as already observed, is adopted as a standard burner in all the Acts of Parliament by which the operations of gas companies are controlled. Of course when defining this the dimensions and number of the holes, together with the dimensions of the burner and chimney are all given in order to attain uniformity in the light yielded by the different kinds, when consuming a given quantity of gas.

Fig. 4.



A good argand burner when consuming 5 feet of gas per hour, of the average quality supplied in light of seven candles corresponding with the respective numbers, it yields but that of 2·8 or about 2¾ candles; and when further reduced to 2 feet, instead of the light of three candles only that of one candle is obtained; and when of course only one-third of the available light is evolved by the gas. Again, if the flame be still further reduced so as to consume 1¼ foot per hour, only a blue ring of flame will be perceptible, which is practically devoid of light; but if the glass chimney be now removed the gas will give about the light of a candle.

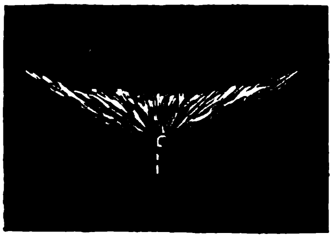
Fig. 5.



These facts are mentioned in order to explain the very peculiar circumstances which control the degree of light yielded by gas, and thus we learn that on reducing the flame of an argand burner, for the light suming the gas under favourable conditions, the flame being clear, bright, and flagging, the last circumstance arising from the feeble pressure at which the gas issues. It is desirable that the slot of these burners should be always clear, otherwise, in the event of any obstruction existing, the flame will be "forked" or "jagged" when the gas is consumed disadvantageously.

The annexed engraving, Fig. 7, represents a batwing burner flame under almost the worst circumstances, in which four or five times the requisite quantity of gas is passing, the light evolved is exceedingly feeble, accompanied with a roaring noise, and nearly the whole of the gas is wasted. From this point to the condition where the gas is employed with due economy, of necessity there must be a loss, in proportion to the imperfect method of burning the gas.

Fig. 7.

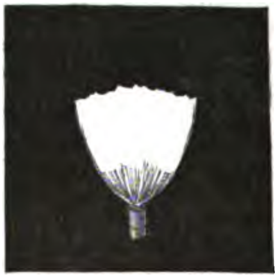


Batwing burners are generally employed in the lamps for lighting the public streets, each of which is provided with its corresponding regulator beneath, in order to consume the gas economically and prevent loss, and in imitation of the gas companies' example, consumers should adopt the use of similar instruments, to which reference is made under the head of "regulators." Ordinary batwing burners, as stated, consume about 5 feet per hour, but the largest descriptions often burn 7 feet per hour, that is, when the gas is properly employed and producing a good flame, as shown in Fig. 6. The larger sizes of the batwing and fishtail burners give considerably more light for a given quantity of gas than the smaller descriptions. Each size burner requires a definite quantity of gas in order to produce the greatest degree of light, but the loss arising from an excess of gas is much greater than that from a deficiency.

THE FISHTAIL BURNER.

This is formed by a nib similar to the batwing, but instead of having a slot it is provided with the holes drilled at an angle to each other, so that the two streams of gas on issuing therefrom impinge against each other, and thus form a flat flame at right angles to the line of the two holes, somewhat in the form of a fish's tail, from which its name is derived. The flame of this, burning under good condition, is shown in Fig. 8 and, like the batwing already mentioned, it is clear and bright, with the lower part tinged with blue, with its upper edge vacillating or wavering; and

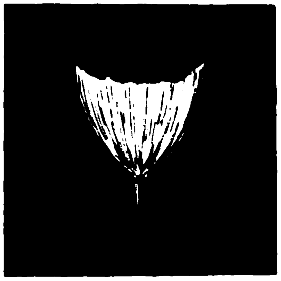
FIG. 8.



we may observe that with a perfectly steady fishtail flame the gas is never used economically. The general observations concerning the batwing burner are equally applicable to that in question.

Whenever the pressure of the gas is slightly excessive the flame of the fishtail acquires a blue tinge, and is irregular on its surface, as represented in Fig. 9,

FIG. 9.



but if the pressure be still further increased, the gas issues with a roaring noise, accompanied with a very considerable loss of light; and, similar to the batwing, the pressure may be further augmented to that degree when no light whatever is evolved by the gas.

Fishtail burners are very generally adopted in private dwellings, and as usually applied are exceedingly extravagant, for if we assume that one of these gives a maximum degree of light when burning 4 feet per hour, then by increase of pressure in the company's main, 6 or 7 feet of gas will pass the same burner without any increase of light, or indication of the loss. The means of remedying this evil is with the "controller" hereafter mentioned.

The universal application of the fishtail burners arises from their adaptability to globes or moons, which are usually employed in private dwellings, and with the means of controlling the pressure they are exceedingly desirable.

Following the law already alluded to when speaking on the argand, the larger the fishtail or batwing burner up to a certain consumption of about 7 or $7\frac{1}{2}$ feet per hour, the greater is the degree of light evolved by the gas, as made evident by the following table:

A fishtail consuming	$1\frac{1}{4}$	ft. per hr.	yields the light of	$1\frac{1}{10}$	candles.
"	$2\frac{1}{2}$	"	"	$2\frac{3}{4}$	"
"	$3\frac{1}{2}$	"	"	$6\frac{1}{2}$	"
"	$4\frac{1}{2}$	"	"	10	"
"	5	"	"	$12\frac{1}{2}$	"
"	7	"	"	18	"

In the experiment to which the table refers all the various burners yielded the maximum of illumination at the consumption indicated; hence, we find for a given light derived from the gas, that the smallest description is upwards of three times more expensive than the largest, and in addition to this extra cost the flame of small fishtail burners has always a blue tinge, which is communicated to the whole of the locality lighted by such means; for these reasons, therefore, the smallest burners should never be employed. The most suitable fishtail burners for use in private dwellings should consume about $3\frac{1}{2}$ to 4 feet per hour, and that description known as "Bray's" is about the best in use, as by means of these the gas is prevented in a great measure from going to waste, when there is any extraordinary pressure, and their cost is very trifling.

THE SINGLE JET BURNER.

This is a simple jet flame, similar to that of a candle, but is seldom used in London and the provinces, except when only a very small flame is desired, as at countinghouse desks for sealing, and pipe-light burners. With the richer descriptions of gas, such as produced in Scotland, it is very commonly employed, but only where a limited degree of light is required.

No iron burners of any description should be used, for in consequence of their rapid corrosion they become obstructed, when the light derived from them is at once diminished, and the price of the gas for the light obtained is augmented. And in order to further demonstrate the importance of good burners we may observe that a gentleman, a well-known gas engineer, having occasion to report on the state of a gas company supplying a provincial town, ascertained that the burners employed by the majority of the consumers were so defective that they yielded only one-third of the light that could be derived from the gas. Thus, although the price was but 3*s.* per 1000 feet; by the act of the consumers themselves for the light obtained, the gas was increased to 9*s.* per 1000 feet, and we see examples of this in every street and almost in every house.

From the foregoing observations we learn:

That according to the construction of burners, and the pressure with which the gas issues, so will be the amount of light derived. A proper burner will give the maximum of light from the gas, whereas an imperfect one diminishes it very materially; and it is even practicable, by bad burners and high pressure, to consume gas without it yielding any light whatever.

That when the flame of the argand is diminished, a greatly decreased light from the gas is the result; therefore it is essential that the full quantity for which the burner is made should be consumed.

That with all classes of burners the light obtained from the smallest sizes is always costly—in many instances the consumer by using them, pays two or three times more for lighting his premises than would be necessary if proper burners were employed; and an error frequently committed by gas consumers is to employ a large number of small burners instead of a few proper ones, when, in addition to the increased cost, establishments lighted by these means have always a dull appearance. Having such burners the consumer should not hesitate to replace them immediately, for the expense is speedily repaid by the economy effected and brilliancy of light obtained.

To give some idea of the consumption of various burners, a jet similar to the flame of a candle will consume about ¾ of a foot per hour, but for the light given this is an extravagant method of using gas. A small useful fishtail will burn 2½ feet of gas, another as usually employed in dwellings, will consume 4 feet an hour.. An ordinary batwing, as employed in the public lamps of the metropolis consumes 5 feet, and a large burner of the same description, as often employed in open shops, will burn 7 or 8 feet an hour, but, as already observed, by any excess of pressure these quantities are readily exceeded without any increase of light, and frequently with the very opposite result.

GAS METERS.

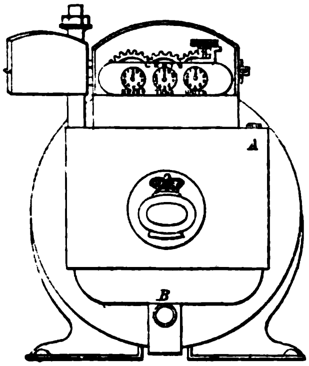
There are two kinds of gas meters, one of which requires to be partially filled with water in order to render it operative, and for this reason it is called the *wet* meter. The other being complete in itself, and not requiring the aid of any liquid, is termed the *dry* meter.

By Act of Parliament all these instruments are examined, as to their accuracy, similar to ordinary measures and weights, by inspectors duly authorized for that purpose, and on being found correct are stamped officially, when they become acknowledged as legal instruments for the measurement of gas.

THE WET METER.

The annexed figure (10) represents an ordinary wet meter, and consists of an outer cylindrical case, in

FIG. 10.



which revolves a drum divided into four distinct compartments, each of which receives and delivers the gas alternately; thus, if we suppose the capacity of each compartment to be equal to one quart, the drum in revolving would receive one gallon of gas (about the sixth part of a cubic foot) from the company, and deliver it to the burners to be consumed. Hence the contents of one revolution of the measuring drum being known, it is evident that by very simple mechanism the continuous action of the instrument can be recorded on the dial of the index.

The wet meter, although generally considered more durable and more reliable as a measurer than the other, possesses some disadvantages, as, for instance, when it is exposed to the effects of a severe frost, the liquid within freezes and stops the supply of gas. Or when placed in a very warm locality, the water rises in vapour, which afterwards becomes condensed in the pipes, and if these are not properly placed the passage of the gas will be obstructed, producing what is known as "jumping lights."

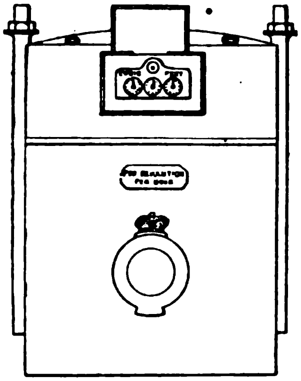
The means of avoiding the first-mentioned evil is to place a small portion of glycerine intermixed with the water within the meter, or embedding the instrument in straw, sawdust, old carpet, or any other non-conducting material, which will prevent the water from freezing. Should, however, the meter be stopped by the liquid within freezing, a small quantity of boiling water should be poured in at the filling plug, A, and after leaving it about ten minutes the excess of water should be allowed to flow off from the lower plug, B. But sometimes the whole of the lights supplied by a wet meter are suddenly extinguished, or the gas will not light. The first defect may arise from the meter receiving a blow, or more probably from an insufficiency of water, in which case the plugs A and B being removed, a small quantity of water is gradually poured in at A until it flows from B, and on this ceasing the plugs are replaced and the gas can be lighted. The second evil may be caused by an excess of water, which can be removed by taking out the plug B and allowing it to flow. In the event of a meter being defective, should this be supplied by the company, on making the complaint in writing, it will be attended to without delay, and another meter substituted.

THE DRY METER.

The dry meter will be readily understood by reference to the ordinary house bellows, in which we find that each time the flap is raised a quantity of air enters the instrument, which is expelled through the nozzle by depressing the flap; thus, if we suppose the quantity of air entering and expelled at each operation of lifting and depressing the flap to be known, then by means of simple wheelwork the number of times the action is repeated, or in other words, the quantity of air entering and issuing from the bellows, could be recorded on a dial or index with the utmost certainty.

The accompanying figure represents a dry meter as now universally constructed, which was the invention of the author of the present pamphlet. In this there are two working parts similar in action to that of the bellows, by which means a constant and regular supply of gas is maintained. The instrument is necessarily delicate in its construction on account of the nature of the subtle fluid it measures, and like the action of the wet meter, the gas passes to and from four distinct chambers; and the capacity of one complete operation being known, the quantity of gas passing is recorded by suitable mechanism on the index of the meter.

Fig. 11.



the company; but supposing, by extraordinary circumstances, the gasfitter cannot obtain light otherwise than by displacing it, the consumer is then bound without delay to inform the company of such an act, and thus prevent annoyance and disagreements which might otherwise occur.

All places of public resort should be supplied by at least two meters, which ought to communicate with each other, so that in the event of one of them failing —an occurrence sometimes experienced with the wet meter, caused by the evaporation of water—the other continues the supply, which, although perhaps inadequate to the wants of the establishment, yet avoids the alarm and confusion attending a total extinction of lights, and the defect can afterwards be easily remedied at leisure.

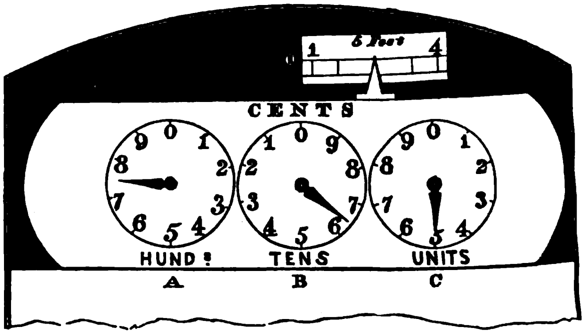
INDEX OF THE GAS METER.

The recording part of the gas meter, or, as termed, the index, is often a stumbling-block with consumers, and it is a matter of astonishment that people do not take a little pains to understand this simple instrument, instead of complaining of its mystery, and remaining dissatisfied, as with only a few minutes' attention a knowledge of it may be acquired.

Figure 12 is a drawing of the ordinary index used for wet meters supplying up to ten lights. When of larger capacity than these the index is provided with four and sometimes five dials. The cylinder O at the top receives its motion from the measuring drum already referred to, and in revolving indicates by means of the fixed pointer the units of feet passing. This is intended for testing the accuracy of the instrument by short experiments; it likewise serves for the consumer to make any brief periodical observations of his consumption; and, lastly, to ascertain if there be any loss or leakage on the premises.

On the upper part of the dial is the word *cents*, signifying that cents or *hundreds of cubic feet* are indicated. There are three circles, marked for distinction in sketch A, B, C. Under the circle C is "Units," denoting that its pointer indicates units of cents, or *hundreds of feet;* and, as shown, the quantity of 500 feet of gas has passed. But in due time, when 1000 feet will have been consumed, the pointer will then arrive at zero, and if no provision were made to avoid it, the account would be lost.

Fig. 12.



This, however, is prevented by circle B having beneath it "Tens," denoting tens of hundreds, or *thousands of feet.* Thus while the pointer of circle C makes an entire revolution, that of B moves from one figure to the next. As represented, it is beyond the 6, indicating 6000 and a fraction of 1000, which fraction is the 500 recorded on the circle C, making together 6500 feet.

Here, again, for ordinary purposes, a higher denomination is required, which is furnished by the circle A having beneath it "Hundreds," that, is hundreds of cents, or *tens of thousands.* Thus the pointer of this circle indicates the tens of thousands of feet passed, and, as represented, it is some distance beyond the 7, indicating that 70,000 and a fraction of 10,000 namely, the 6500 recorded by the other dials, making altogether 76,500 feet of gas, which have passed to the consumer's premises.

The preceding detail is necessary for the purpose of explaining the operation of the index, but in practice a much simpler method is adopted in order to ascertain the consumption, which is accomplished by merely noting on paper the numbers each respective pointer *has passed*, and marking them in the position as seen; thus 765, and afterwards by adding two cyphers (00) for the cents, we have 76,500 feet the quantity indicated by the meter.

It is imperative to take the numbers the pointers have passed, inasmuch as that of A could not be at 8 until that of B arrived at zero, and this could not occur until the pointer of C had made the necessary revolutions.

Although the index of the dry meter varies slightly in its superscription, it is in reality identical with that described, the difference consisting in the dry meter index recording "cubic feet," instead of "cents," and each of the circles having above or beneath it the total quantity indicated by a complete revolution of its respective pointer.

The method of ascertaining the consumption is the same as that described, by noting the figures the hands have passed. In large meters there are sometimes four or five dials; the mode of operation is by merely adding other corresponding figures.

Supposing the consumer to understand the index of his meter, it then becomes his duty to keep check against the officers of the gas company, in the same manner that he verifies goods and invoices delivered by others; and although if an error were to be committed by taking the wrong account one quarter, it might be rectified the next, still it is far better to avoid the possibility of misunderstanding.

The inspectors of most gas companies leave a statement of the meter index, with the quantity consumed at the time of making their observations, which the consumer should take the trouble to verify.

The manner of keeping the statements of the meter is exceedingly simple. For the purpose of explanation we will imagine the indication at the end of a quarter to be 96,700, and that of the previous quarter 89,300; the latter quantity subtracted from the former gives a consumption of 7400 feet during the intervening period. To illustrate a difficulty which sometimes occurs, let us conceive that the consumption during the following quarter is 5600, when on referring to the index we find it only shows 2300. This is often a cause of surprise, but as the meter can indicate only up to 100,000, it follows that in reality this must be 102,300, from which the former consumption is subtracted. In all subsequent observations the higher denomination is omitted.

It is often argued by dissatisfied consumers, as there is wheel or clockwork in a gas meter, that, like the clock, it must be subject to variation, which assumption is quite erroneous. The wheelwork of a clock is the perfection of mechanism, for it records faithfully and continuously the vibrations of the pendulum; which vibrations are made to correspond with certain periods of time, and so long as the pendulum moves at the precise speed calculated, the clock will be correct, but any deviation from this causes it to vary. Therefore the defect is not occasioned by the wheelwork but by the pendulum.

With the gas meter the wheelwork records on the dial the number of times the measuring chambers have been filled and emptied. These under ordinary conditions are not susceptible to any material variation, so that there is no analogy between the action of the two instruments, except as regards the unfailing accuracy of the wheelwork.

Nevertheless it is within the range of possibility that a meter may be wrongly constructed, or, still more likely, that when undergoing repair it may be made in such a manner as to indicate incorrectly. Therefore under extraordinary circumstances, where there is an excessive or deficient amount of consumption recorded by the meter, its accuracy may be questioned, and which can only be proved by passing some hundreds of feet through the instrument.

THE PROPER POSITION FOR GAS LIGHTS.

Among other questions of importance in connection with gas lighting is the most suitable position for placing the lights, which, according to our every-day experience, is frequently neglected, particularly in the drapers' shops of London, where the invariable system is to crowd a number of burners into the window among the goods exhibited, by which means the glare of light fatigues the eye and the intended object is defeated.

It is a well-known fact that, when anyone is seeking an object in a dark place with a lighted candle, in order to be enabled to see the better, the first impulse is to screen the flame from the eyes by the hand, otherwise its glare impedes the vision. Or when the sun shines on the eyes of an individual, in like manner he shades them, in order to see any object or person at a distance off; and these simple operations ought to be imitated in gas lighting, for all objects are always seen to more advantage, or with greater facility, when the flame illuminating them is hidden from the spectator; therefore if the lights in the shops referred to were shaded on the side nearest the observer, the goods would be shown under more favourable conditions. Or if a pulpit or lecture table be illuminated by unscreened lights, the preacher or lecturer is seen under considerable disadvantage; but if these be screened by suitable shades, so that the light falls on the individual, but is hidden from the assembly, the difference will be found to be considerable. In the latter case every outline is well defined, every change of expression is observed with facility, and the eyes of the spectators are not fatigued. The same principle applies to the lighting generally, whether for churches, theatres, shops, or private dwellings.

Undoubtedly the best means of illuminating large public edifices is the "sun-light," invented by the late Mr. Alfred King, Liverpool, which consists of a dome-shaped reflector attached to or suspended from the ceiling and provided with two pipes, one of which carries off the products of combustion to the exterior of the building, and the other admits air to supply the burners. In the centre of the reflector are a number of batwing or fishtail burners placed in a horizontal position so that their light is reflected below. In churches where the apparatus is of large dimensions about forty-eight burners are generally used, two of which apparatus will light an edifice having eight hundred or one thousand sittings. The light from the sun burner is exceedingly agreeable, and the system possesses the further advantage that it ventilates the building in an admirable manner.

In addition to the purpose of illumination these sun-lights are commonly used in banking houses and other large offices in London during the day-time for ventilation, when, of course, the quantity of gas used is limited. When applied for this object, the tube for the admission of fresh air from the ceiling can be dispensed with, or closed by a valve, as one pipe is sufficient to carry off the heated air, and fresh air is supplied in the lower parts where required. Sun-lights are also frequently applied to shop windows, with excellent results.

An error often committed in fixing these lights is to place them too high up; indeed, in some cases when the roof is of great height, the tube is dispensed with and the reflector is attached to the ceiling, which arrangement increases materially the cost of gas, inasmuch as the light is diminished very sensibly in proportion to the increased distance of the burners from the desks or other places required to be illuminated. Therefore the burners should always be placed as low as consistent with general appearance, taking care that in churches, the reflector does not cast a shade on the persons assembled in the galleries or the upper part of the building.

The only objection that can be raised against this class of apparatus when used in churches is that the columns and galleries produce heavy shadows, so that whilst one part of the building is well lighted, the other is in comparative obscurity. This, however, is counteracted by having a few lights fixed under the galleries, attached to the back of the columns, or wherever they may be desired.

Most classes of merchandise are exhibited under the best conditions when the light descends from above, there being provided suitable reflectors to throw the light on to the goods. As examples of this system of lighting in many first-class tailors' shops in the metropolis, where the windows are formed of single sheets of plate glass, and the premises fitted up with considerable taste, regardless of expense, the windows are lighted with burners and reflectors placed at the highest points, which is undoubtedly the most perfect method of illuminating goods placed in a horizontal position. In such cases the articles are exhibited to the very best advantage, and the eyes of the observer are not fatigued.

For illuminating shop windows where goods are placed close thereto, such as jewellers', hosiers', and similar trades, the outside reflecting light is the best adapted for the object. These, however, possess the disadvantages of being very troublesome to place and remove every night; and in rainy weather they offer much obstruction to passengers with umbrellas. Some improvement in this is very desirable. There are, however, other localities, such as taverns and public-houses, where the principal object is to have a number of lights as a source of attraction, without any other apparent object.

In lighting dwellings one rule should be imperatively followed: that is, in all sitting rooms, reception or drawing rooms, and even kitchens, the light should be suspended from the centre; and if the apartment be sufficiently high, care should be taken to keep it above the level of the eyes of the occupants.

In many places the error is committed of attaching bracket lights to the walls of apartments. This plan should never be adopted except in sleeping rooms, passages, or places where the light is immediately over the desk or reading table. When applied in apartments, brackets are exceeding unsightly—the light is in the wrong place: it is costly, inconvenient, and disagreeable.

THE GAS REGULATOR.

Various circumstances in connection with the distribution of gas, cause the pressure, or force, with which it is expelled from the company's pipes, to vary in such a manner as to occasion great irregularity in the supply to the consumer's premises—sometimes, there being just a sufficiency, and at other times a superabundance, of gas, and under these conditions either a considerable portion of it passes off imperceptibly in waste, or with the production of smoke, and often accompanied with breakage of glasses, which inconveniences are avoided by the use of the "gas regulator."

This instrument is self-acting, and, as its name implies, "regulates" the pressure of the gas to any desired degree. The simplest of the kind is called the dry regulator, and is formed of an outer cylindrical case made of tin plate, or cast iron, which for five lights is about 4 inches in diameter and 2 inches deep. Beneath is fixed the screw or "union" for attaching to the meter, and above is a corresponding union for connecting with the supply-pipe to the premises. Within the case is a horizontal flexible partition of very thin pliable leather which divides the case into two separate compartments. In the centre of the partition is suspended a conical plug adjusted to a corresponding orifice through which the gas passes in its passage to the burners. Thus the diaphragm being weighted so as to deliver the gas at a certain pressure, whenever this is exceeded, the diaphragm is raised and closes the orifice for the passage of the gas to the extent necessary to supply the burners in use.

Thus by this instrument the pressure of the gas can be controlled to that degree by which the maximum of light is derived from the gas, and whether one burner or all on the premises be lighted, it is equally effective. Hence with this apparatus by the employment of good burners mentioned under the head "burners," and adjusting the pressure to the proper extent, the maximum of light will then be obtained from any given quantity of gas, and under these circumstances there is no waste and but little smoke.

The economy to be derived from the use of the regulator will depend on various circumstances, such as the pressure of the gas in the district, the care previously employed in adjusting the lights, the description of burners used without and with the instrument in question; but it is by no means an uncommon circumstance for a saving of 30 and even 40 per cent. to be effected by the regulator and still retaining the same amount of light. However, in order to obtain the full benefits of the apparatus, proper burners are indispensable, and the fittings should be of ample capacity to permit of the passage of the gas at the desired low pressure.

There are, however, some localities, although exceedingly rare, where the pressure is so weak and uniform as to render the instrument in question superfluous, but wherever there is any irregularity of the pressure as supplied by the company, then for the purposes of economy and comfort the regulator is indispensable.

In large establishments of several stories high, a separate regulator is essential for each floor, in consequence of the gas having a tendency to flow to the upper part of the premises, where a good supply will often exist, whilst the lower part of the building is in comparative obscurity. Another similar instrument to that in question, called the "controller," is adapted to each burner, and which only permits a certain quantity of gas to pass; by these means waste is prevented; and the burners being of the most suitable description, the gas is always consumed under the most favourable conditions.

But with all the advantages enumerated that these instruments possess, they are not generally recommended by gasfitters; for the simple reason that there is little profit attached to them, and perhaps because they make known any defect that may exist in the fittings; and it frequently happens that when there is a partial stoppage in the pipes, in the event of a regulator being on the premises, it is most urgently condemned by the gasfitter, and removed, to the great prejudice of the consumer. This, however, should never be permitted, for although the instrument prevents an excess of gas from passing, on the other hand it allows a free passage for the gas whenever the pipes throughout the building are of ample capacity, and should any alteration be requisite to effect this, the expense for that purpose would be trifling when compared with the economy to be derived by the employment of the instrument in question. Hundreds of regulators have been displaced from circumstances similar to those mentioned, bringing upon them an amount of discredit which they never merited, and occasioning a vastly increased expenditure for gas.

The term regulator is, however, very frequently misapplied to arrangements which do not fulfil the object desired. Some of these are small vessels filled with tow, cotton, shot, and similar materials, attached to the burners, which obstruct the passage of the gas when the pressure is great, but they likewise prevent a proper and sufficient supply under opposite conditions. Indeed, instead of economy resulting from their use, sometimes the contrary takes place, arising from the consumer relying on the efficiency of the instrument, and neglecting to pay that attention to the adjustment of the taps which he observed previous to their use. The term is also applied to a mode of adjusting the main tap by means of wires in communication with a dial. This, although useful, demands repeated attention, and never ensures the economy and advantages to be derived from the regulators described.

VENTILATION.

It has been repeatedly proved, that gas for a given quantity of light produced is more salubrious than any other material employed for the production of artificial light; but on its introduction into any place a considerable increase of light is invariably required, when a proportionate augmentation of heat and noxious products are the natural results, and in consequence additional care must be adopted in order that the ventilation shall be in accordance with the altered circumstances.

For the purpose of making the subject of ventilation intelligible we will submit to the reader's notice a few observations on the chemical nature and properties of our atmosphere, together with the compounds formed during the processes of combustion and respiration, and the action of these on the human frame.

The air we breathe is composed of two gases, namely, oxygen and nitrogen, in the proportions of about one-fifth part of the former and four-fifths of the latter. The oxygen may be termed the "aërial food" for fire and animal life, as both are entirely dependent upon it for existence. The other gas, nitrogen, may be considered the diluent of this, and possesses no life-sustaining properties, and is intended by Nature simply to moderate the action of the former.

To illustrate the action of oxygen: if a glass tumbler or similar vessel be inverted, on placing a lighted taper therein, gradually the flame diminishes, and is speedily extinguished—this being due to the oxygen of the enclosed air combining during combustion with a portion of the material forming the taper, which assumes the gaseous state, and produces a poisonous compound, called carbonic acid, which suffocates the flame. But if previous to extinction a stream of oxygen gas were to be injected into the inverted vessel, the flame would revive, and burn with an intensity proportionate to the quantity of that gas supplied.

Or if a number of persons be assembled together in a confined place where the supply of fresh air is limited, they, by the process of respiration, in a manner analogous to the action of the fire, vitiate the air and produce the same poisonous compound, carbonic acid; and when the air is contaminated therewith, it is productive of lassitude, headache, and sickness to the persons breathing it. Should the atmosphere inhaled by the lungs contain only one per cent. of that poisonous compound it becomes exceedingly unhealthy; and when it contains from three to four per cent. persons breathing it would speedily die; but by the timely administration of oxygen gas, or fresh air, of which it is a constituent, the calamity might be averted.

Thus we learn that oxygen, or fresh air which contains it, is most essential to fire and animal life, that when it contributes to the one or the other a poisonous compound is formed, which when breathed even in a limited quantity is injurious to the human frame. This poisonous compound may be formed so as to be pernicious by one person or many, dependent on the locality and means of ventilation. Or it may be produced by lights, as candles, lamps, or gas, burning in a very confined place, but by resorting to proper means, the evils arising from this pernicious compound may be averted, which is the object of ventilation.

Carbonic acid, like all other gases, is readily diffused, and it is carried by the winds from cities and towns, where it is largely generated, to supply the vegetable kingdom, to which it is a source of alimentation; and following this law of nature, proper facility should be afforded in all buildings to permit of the escape of the vitiated, and the admission of pure air.

Another effect produced from flame of all ordinary descriptions, is the production of vapour or water, caused by the oxygen of the atmosphere combining with the hydrogen which constitutes a portion of the material consumed; and in the act of combustion, water is produced, which exists as vapour in the air wherever there is a flame; therefore in proportion to the gas light so will be the amount of vapour formed.

The presence of these vapours is made palpable in several ways, and for this purpose if a decanter of iced or very cold water be taken into the atmosphere of a room which is apparently quite dry, speedily the surface of the decanter will be covered with a thick dew, caused by the vapour floating in the atmosphere being condensed on the decanter by the action of the cold water within. Or, in frosty weather, when a gas light is burning in an apartment, the vapour arising therefrom will be condensed upon the glass of the windows and become frozen.

We have therefore in ventilation two considerations —the one to have the full quantity of fresh air necessary to our health and comfort; and in certain places to avoid the accumulation of vapour, which may be highly destructive to many classes of merchandise; and although the means employed for the effectual fulfilment of the first requirement would accomplish the second, still we have thought it better to embrace the two subjects, as the latter will explain many causes of complaints of gas consumers.

The effect of the heat and vapour from combustion is frequently very objectionable; for instance, a wareroom or shop, the lower part of which may be only at a temperature of from 60° to 70°, in consequence of the hot air ascending, and there being no means of its escaping, the temperature near the ceiling in the same apartment will probably be 130° or 140°. Therefore when goods or books exist in such localities, and are subjected to this high temperature with the corresponding vapour, it cannot be a matter for surprise if they become injured or destroyed. And although the preventive is exceedingly simple; instead of this being applied, the defect is at once attributed to the bad quality of the gas. For the proper protection of goods when placed in such localities, a good system of ventilation is necessary, in order to permit the hot air and vapour to pass off freely from the uppermost part of the premises.

When gas lights are in enclosed places, as shop windows, good ventilation is indispensable, or the vapour will be condensed upon the glass, entirely obscuring it. Sometimes in winter this vapour is found frozen on shop windows, arising from the fact of a gas light having been burnt in the premises, or perhaps a person having slept there, and the vapour from his breath, being condensed on the window, is there frozen.

Although apparently so simple, the general question of ventilation is very difficult to treat with, for sometimes the means adopted to ensure a good supply of fresh air may answer admirably for a period, but unexpectedly, perhaps from a change in the direction of the wind, suddenly it is found to be defective, and, to the great disappointment of the proprietor, the system has to be abandoned. Arrangements which may be perfection in calm or warm weather, are often the opposite in cold or boisterous weather, when, instead of the noxious products of combustion passing off, the wind rushes with occasional gusts, causing the flame to become agitated and smoky, and necessitating a discontinuance of the method of ventilation.

Perhaps the best method to be adopted when gas is much used in dwellings, warehouses, and shops, and other places where no provision for the ventilation has been made by the architect, is to adopt a valve similar to Dr. Arnott's, which should be under control when cannot be overrated; but frequently people by custom become habituated to breathe impure air. In many workrooms the atmosphere is almost insupportable to those who enter casually, yet the occupants experience no inconvenience from it at the time, but slowly impure air does its baneful work, and from which many cases of consumption and other diseases have their origin.

Badly ventilated workrooms are detrimental in a commercial point of view, inasmuch as the inhabitants possess considerably less energy than they would have with proper ventilation, and consequently less work is done. Therefore it is the direct interest of employers to consider well this important point.

In public places of amusement, the means of ventilation are too frequently neglected, the natural consequences being, that in summer time, on this account alone, they are less patronized, for who can possibly consider it amusement to sit in a state of perspiration and gasping for breath, as is often the case, and sacrificing the comforts of a moderate temperature, and a fresh and healthy atmosphere, which can be obtained by leaving the building?

A good system of ventilation may be applied in such places by means of a fan, or vane, set in action by motive power or manual labour, with a judicious disposition of flues to conduct the supply of air to those parts of the edifice wherever requisite.

Fresh air costs nothing, therefore bad ventilation should be always avoided, for assuredly when this exists, its pernicious effects will be made manifest sooner or later to a greater or less degree in those persons who are subjected to its influence.

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